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ABSTRACT

In this study, the effects of rewards on same-different judgments of size, color, and weight were investigated. Subjects were 45 children at the kindergarten and first-grade level. The children were assigned to one of three conditions: (1) rewarded for reporting black in the identification of the colors of balls contained inside gray jars, (2) rewarded for reporting white in the same task, or (3) not rewarded. Subjects were then required to respond "Same" or "Different" in size judgments of black, white, and gray discs presented for comparisons. Same-different judgments of the weights of black, white, and gray jars were also investigated. Results indicated that reward training did not differentially affect the same-different judgments of sizes or weights. However, differences in the mean discriminability of experimental groups and a suggestion of a contrast effect were demonstrated. Results and methodological changes in investigations of motivational factors on judgment are discussed. (Author/SB)

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A Methodological Analysis of Reward on Same-Different Judgments in Children

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Running head: Analysis of Reward on Same-Different Judgments

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Abstract

Forty-five children at the kindergarten and first-grade level were (a) rewarded for reporting black in the identification of the colors of balls contained inside gray jars, (b) rewarded for reporting white in the same task, or (c) not rewarded. Subjects were then required to respond "Same" or "Different" in size judgments of black, white, and gray discs presented for comparisons. Same-different judgments of the weights of black, white, and gray jars were also investigated. Results indicated that reward training did not differentially affect the same-different judgments of sizes or weights. However, differences in the mean discriminability of experimental groups and a suggestion of a contrast effect were demonstrated. Results and methodological changes in investigations of motivational factors on judgment were discussed.

A Methodological Analysis of Reward on Same-Different Judgments in Children

In the 1940's and throughout the fifties, a movement emerged in the psychology of perception referred to as the "New Look". Central to this approach was a departure from the consideration of merely the physiological determinants of perceptual processes and an emphasis on the influence of personal attitudes, autistic factors, needs, and motivation on perceptual organization. Foremost among the proponents of the "New Look" were Bruner and Postman whose directive-state theory of perception comprised one of the initial and major theoretical frameworks upon which the movement rested (Allport, 1955; Bartley, 1969).

In contrast to the formal theories of perception which concentrated on, according to Bruner and Postman, purely "autochthonous" or structural components in the act of perceiving (the stimulus and its effect on the sense organs), directive-state theory was said to be functional and stressed behavioral and motivational factors largely overlooked in the bulk of research on perception conducted during that time. According to directive-state theory, behavioral determinants such as the needs, values, emotions, and past experiences of an individual form a central directive state which colors perceptions such that they reflect the attitudes, motives, and, perhaps, even the personality of the perceiver. Thus, rather than consider behavioral factors as extraneous elements that must be controlled, those experimenters adhering to directive-state theory treated motivational determinants as independent variables so as to discover their effect upon perception in total -- how, what, and why the individual sees something as he does (Allport, 1955; Bruner & Postman, 1949).

A number of studies have demonstrated that stimuli with which rewards have been associated tend to be dominant or enhanced in the individual's perceptual field (Lambert & Lambert, 1953; Lambert, Solomon, & Watson, 1949; Proshansky & Murphy, 1942; Schafer & Murphy, 1943; Snyder & Snyder, 1956; Sommer, 1957; Sommer & Ayllon, 1956). Assuming, however, that the reinforcing value is relevant and constant for each subject in the studies cited, Sommer (1957) has noted two major views concerning the influence of reward on perception. One, the need-satisfaction theory, proposes that in a situation of perceptual choices, the alternative associated with reward will be perceived more often when paired with either a neutral or punished alternative. A second position favors Tolman's emphasis theory, according to which that perceptual choice related to the greatest intensity of affect, be it positive or negative, will be dominant in perception as compared to a neutral stimulus.

Recently, Klinger (1975) has reformulated the concept of reward or reinforcement as it relates to theories of motivation and perception. Noting the theoretical difficulties emerging from an overinclusive definition of drive, Klinger proposes that the subject's expectations that a behavior will lead to an incentive are in and of themselves sufficient to initiate a sequence of goal-directed behavior. In place of the concept of drive or reinforcement, then, Klinger asserts that incentives increase the organism's responsiveness to incentive-related cues. Relating the role of incentives to studies of perceptual accentuation or enhancement (Bruner & Goodman, 1947; Lambert, Solomon & Watson, 1949) and need states (Gilchrist & Nesberg, 1952; McClelland & Atkinson, 1943), Klinger attributes the results to incentive expectations rather than to the effects of drive.

The reference experiment on the affects of rewards on size estimation by children was performed by Lambert, Solomon, and Watson (1949). Two groups of children, ages three to five years, were rewarded for turning a crank handle; the control group received candy directly after turning the crank, and the experimental group, a white poker chip for the same number of turns, which could be inserted into a slot for candy. Size of the poker chip was significantly overestimated by the experimental group and not by the control group. After an extinction procedure in which candy was no longer provided, no significant difference in estimations was obtained between the two groups. In a later study, Lambert and Lambert (1953) showed that when two neutral tokens were placed in a sequence so that they were at different distances from the reinforcement, the token closer to the goal (candy) tended to become overestimated but the one farther from the goal tended to remain neutral.

In both of these studies, however, only one size of token was used and all judgments were made by turning a knob controlling the diameter of a circular patch of light. Several questions arise from these studies: What are the effects of reward on size estimations of objects of different sizes? Does rewarding of a colored object affect subsequent judgments of objects of that color, or of different colors? More specifically, are objects, the colors of which have been associated with reward, judged the same or different in sizes or weights as the nonrewarded ones?

The present experiment was designed to answer these questions. Instead of having only one experimental group, two groups, each rewarded on different brightness values, were used. In this way a more sensitive measure and the differential effects of reward on the different brightness values could be ascertained. It was suggested by Ross (Note 1) from a previous study on

simultaneous size estimation by children (Murray, Note 2) that if rewards act to enhance the perception of brightness, then differential effects on judgments of brightnesses should occur. The argument for this is as follows. After inspecting a disc of a certain size and brightness, a child is then asked to select a disc the same size from arrays of discs of different sizes and brightnesses; then the discs colored the same brightness that was previously rewarded and inspected should produce the least error in size estimation. For example, if black had been rewarded, and the child is asked to select from a black array, little or no error should occur, since the reward supposedly enhances the perception of this brightness. However, if an array of white or gray were presented, and the child was asked to select a disc the same size as the previously black, inspected disc, then greater error in estimation should occur. Finally, the discs used in the present experiments differed very little in size range (1/4") and were presented successively so as to augment the response biases to the rewarded brightnesses. Additionally, the judgment of weights provided an independent measure of the effects of reward on judgments.

Method and Procedure

Subjects

Forty-five children (twenty-five girls and twenty boys), 5, 6, and 7 years old, served as subjects. The mean age was 5.9 years. With the exception of one child obtained from the Randolph-Macon Woman's College Nursery School, all subjects were students at the kindergarten or first-grade level at Villa Maria Academy in Lynchburg, Virginia.

Size

Pretraining period. Subjects were told by the experimenter that they had been selected to participate in a game that had to do with things that were the same in size and things that were different in size. To allow familiarity with the task and to assess the subject's understanding of the concept of same and different with respect to size, the experimenter proceeded with a pretraining task as an illustration of how the "same size — different size" game was to be played. Here, two shapes (triangle and circle, the center points of which contained a circular hole) of three different sizes and different colors were used. There were two examples of each size, making a total of six triangles and six circles of six different colors — red, green, blue, orange, yellow, and purple. The sides of the equilateral triangles measured 3 in. (7.62 cm), 4 in. (10.16 cm), and 5 in. (12.70 cm), respectively, and were classified as small, medium, and large. The diameters of the three circles were 3 1/8 in. (7.9375 cm), 3 1/4 in. (8.255 cm), and 3 1/2 in. (8.89 cm) and were similarly referred to as small, medium, and large in size. Beginning with the triangles, the experimenter placed, in order, a small size (7.62 cm), medium size (10.16 cm), and large size (12.70 cm), each a different color, on a table and asked the subject to report which triangle was the largest, the smallest, and medium size. After the subject had responded by pointing to or naming the color of the correct triangle, the experimenter asked if the three triangles were the same size or different sizes. Using the same three sizes, but triangles of different colors than before, the experimenter varied the order of placement (for example, large, small, medium) and repeated the previous questions. The experimenter then informed the subjects that they

would play another game with the triangles. The subject was requested to sit in a chair placed 1 m away from and facing a 28 sq. in. (71.12 cm^2) plywood board with a 1 1/2 in. (3.81 cm) dowel protruding from the center point of the board. The experimenter told the subjects that they would play the "same size-different size" game in another way. The experimenter explained that she would show the subject a triangle by placing it on the dowel on the board. She would then replace the triangle with another triangle and ask the subject to report whether the second triangle was the same size or a different size than the first triangle shown. A series of six presentations followed in which same-different judgments of comparisons of large-large, large-medium, large-small, medium-medium, medium-small, and small-small sized triangles were made. All subjects completed this task without error. The same procedure was followed using the circles. Because the size differences between stimuli in this case were small, 1/8 in. (.3175 cm) between the small and medium sizes, 1/4 in. (.635 cm) between the medium and large sizes, and 3/8 in. (.9525 cm) between the small and large sizes, errors were made by some subjects. In these instances, the experimenter corrected the subject and repeated the procedure until the subject explained correctly why the circles were the same or how they were different (which was larger or smaller).

Prejudgment. A series of five gray discs, varying in diameter in 1/8 in. (.3175 cm) steps was used. Subjects were told that they would play the "same size-different size" game with these discs in the same manner as with the triangles and circles in the pretraining task. Subjects were required to make same-different judgments of a standard 2 in. (5.08 cm) disc and comparison discs, comparison stimuli being from 1/8 in. (.3175 cm) to 1/4 in. (.635 cm) smaller or larger in size than the standard. As before, the discs were

presented for successive judgments on the dowel protruding from the center of the board. The subject inspected a disc (the order of standard and comparison being varied to avoid position effects) for 5 sec at which time the experimenter removed the inspection disc and replaced it with the test disc for subject to judge as same or different in size. There were eight presentations, four in which the standard was judged against a standard of the same size and four in which the standard was judged against a comparison disc of a different size. Of the presentations in which the standard disc was judged against a comparison disc, there were two trials in which the standard served as the inspection disc and was presented first and two in which the comparison stimulus was presented for initial inspection.

Reward training. Prior to testing, subjects were assigned at random to each of nine groups (n = 5): Black-Black, Black-White, Black-Gray, White-Black, White-White, White-Gray, Gray-Black, Gray-White, Gray-Gray. Groupings indicate the color (brightness) to be rewarded and which color discs (gray, white, or black) would be paired for judgments in the experimental test. Subjects were informed that they were going to play another game. The experimenter showed the subject six gray jars (10.2 cm in height) and explained that each contained either a white ball or a black ball. The experimenter then handed the subject a jar and asked the subject to remove the lid and report what color ball was inside. Three random presentations of each of the six jars followed, making a total of nine reinforcements. Those in black reward conditions (Black-Black, Black-White, Black-Gray) were given an M & M candy for reporting the color black. Subjects in white reward conditions (White-White, White-Black, White-Gray) were given the candy reward for a response of the color white. Those in Gray-Black, Gray-White, and Gray-Gray conditions participated in the game

situation but received no rewards, thus serving as a control group.

Judgment. At the conclusion of the game with the jars, the experimenter informed the subject that they would play the "same size -- different size" game again. Subjects made eight same-different judgments of standard and comparison discs in the manner identical to the prejudgment task except that judgments were of the variously colored discs according to the specifications of experimental grouping. For example, those in the Black-Black condition, rewarded for black, visually inspected a black disc for 5 sec and were then presented with the same size black disc or a comparison black disc of a different size for a judgment. In the Black-White condition, either a black or white disc was presented for inspection and a white or black disc of the same or different size followed, such that a black disc was always paired with a white disc and not with another black disc. The same procedure was used in the conditions utilizing the white and gray discs except that the white color was rewarded and subjects in gray conditions received no rewards prior to judgment.

Postjudgment. In a situation identical to the prejudgment phase of the experiment, subjects made same-different judgments of a series of gray discs.

Weight

Pretraining period. At the conclusion of the size-judgment task, the experimenter requested that the subject play one more game before leaving. After inquiring if the subject knew what it meant to say that some things are heavy and some are light, the experimenter asked the subject to lift each of two cans (10.1 cm and 12.6 cm in height, respectively) by the handle, the smaller one weighing 158 g, the larger, 1435 g. The experimenter then asked which of the cans was heavier and which lighter and if the cans would have the

same weights or different weights.

Judgment. The subject was then informed that he would play the "same weight — different weight" game with some jars. Three sets of three jars each were used. The jars in each set were of the same size (small, 5.3 cm; medium, 10.2 cm; large, 17 cm) and same weight (small, 58.2 g; medium, 270 g; large, 720 g) but of different colors -- gray, white, or black. Subjects were instructed to lift one of the three jars in a set, to put it down, and to then lift a second jar and to report if the second jar was the same weight or a different weight than the first one they had lifted. Judgments were made within each set of three jars separately, and no judgments were made between sets of different sizes. Judgments included a gray jar compared to a white, a black compared to a gray, and a white compared to a black. The order of pairings was determined at random for each subject. In the case of a judgment of "Different", the experimenter asked in what way the second jar differed from the first one the subject lifted so as to determine which jar was perceived as heavier or lighter.

Results

In the analysis of all measures, prejudgment, judgment, and postjudgment, subjects' responses of "Same" or "Different" were converted to proportions in terms of a hit rate (the probability of subject reporting "Same" when the comparison disc was the same size as the standard), a false alarm rate (the probability of subject reporting "Same" when the test disc differed in size from the inspection disc), and the correct rejection rate (the probability of subject reporting "Different" when the test disc differed in size from the inspection disc). The proportions of hit rates and correct rejections were summed to yield a total proportion of correct responses.

In the pre- and postjudgment measures, proportions of hits, false alarms, and correct responses were used to perform a one-way analysis of variance, comparing the means of the three general conditions (Black Reward, White Reward, Gray Control). No significant differences were obtained between pre- and postjudgments of gray discs in any of these measures.

To test for the effects of reward conditions, brightness comparisons, and the interaction of these effects on same-different judgments of the variously colored discs, a 3 (Conditions -- Black Reward, White Reward, Gray Control) by 3 (Brightness Comparisons) factorial analysis of variance was performed. No significant differences were demonstrated in either hit rate or proportion of correct responses. A significant difference in the false alarm rate was obtained, however, for conditions, F (2, 36) = 4.32, $p < .05$. The mean proportions of false alarms were .18, .25, and .36 for the white, gray, and black conditions, respectively. In order to establish the locus of difference, a Newman-Keuls test for individual comparison was performed on the means of these conditions. Results indicated that there were significantly ($p < .05$) more false alarm responses (more subjects reported "Same" when the test disc differed in size from the standard) in black reward conditions than in white reward conditions; no significant differences occurred for the other comparisons. Analysis of the differences in false alarm rates between prejudgments and judgments shows a differential effect of the reward training on the three conditions; the total differences in false alarm rates for the black, white, and gray conditions were .25, -1.5, and .875 in that order. Although these differences were not statistically significant, the reward training increased the total rate of false alarms for the black condition, but decreased the rates for the white and gray conditions.

Although there was no significant interaction between conditions (Black Reward, White Reward, and Gray Control) and brightness comparisons in same-different judgments of variously colored discs, examination of the mean proportions of hits and correct responses suggests a directional effect. In both reward conditions, mean hit rate and mean correct responses were greatest for judgments of same colored discs, for example, black to black or white to white. Conversely, mean hits and correct responses were lowest in comparisons of complementary colored discs, for example, black to white and white to black. These results may indicate the operation of a contrast effect involving brightnesses of the discs paired for judgments. This effect was not demonstrated, however, in gray conditions. The contrast effect is shown for mean proportion correct in Figure 1.

Insert Figure 1 about here

More correct responses were made in reward conditions for same-different judgments of same colored discs than for comparisons of complementary colored discs. Also, as in the case of mean proportion of hits, rewarded subjects made more correct responses in judgments of gray discs (black to gray, white to gray) than in judgments of complementary colored discs (black to white, white to black).

The plotting of mean proportions of hits against mean proportions of false alarms is presented in Figure 2.

Insert Figure 2 about here

These results also suggest the operation of a contrast effect which has appeared as a trend throughout data analyses. As shown, mean hits, were highest and mean false alarms lowest in judgments of white to white discs. Mean false

alarms were highest and mean hits lowest in judgments of white to black discs This seems to indicate a finer overall discriminability in white reward groups. While there was a greater mean proportion of hits in judgments of black to black and black to gray discs than in white reward group judgments (white to white, white to gray), corresponding increases in mean false alarms occurred in black reward groups as well, indicating that higher mean hit rates were accompanied by higher incorrect judgments of "Same" to discs which actually differed in size. As shown previously, the curve representing judgments of control subjects fell between those of white reward and black reward groups. Further inspection of the curves denoting judgments of the three groups indicates the difficulty of the discrimination task required as evidenced by the location of the curves in relation to the area of chance response probability.

In analyzing the data obtained from subjects' same-different judgments of the weights of three sets of jars (black, white, and gray in color), the jars within each set being the same size and same weight, the frequencies of judgments of which color jar was heavier were computed for reward and control groups. Results showed that black reward groups judged gray jars (20 out of 45 comparisons) as heavier more often than black jars (18). Black jars were judged as heavier more often than white jars (16). In white reward groups, white jars were judged as heavier less often (24) than balck jars (27). Control groups judged gray, black, and white jars as heavier about equally often. The proportions of jars judged heavier for the three groups were: .40, .39, and .53 for black, gray, and white in that order. No significant differences were obtained. Theories which propose reward associated objects

to be accentuated or enhanced in size discrimination tasks might have assumed this effect to apply to judgments of weights also. That is, judgments of "Heavier" might be expected to be in the direction of the jars, the colors of which were associated with reward. Further, very few, if any, judgments of differences in the weights of the jars would be assumed to occur in control groups. The above findings, however, do not support these predictions.

Discussion

The results of the present study failed to demonstrate a significant effect of reward training on subsequent same-different size judgments of discs, the brightnesses of which had previously been associated with reward. Neither were the judgments of the weights of jars differentially affected by rewards associated with the colors of the jars.

In view of the negative findings, the present study lends no support to the assumptions of directive-state theory and the argument for the influence of rewards on perceptual judgments. If the predictions of directive-state theory or the postulations of other "New Look" advocates had been borne out, one would have expected evidence for the effects of reward. The results of this study did not indicate significant differences in the same-different size judgments of experimental and control groups as a consequence of reward training. In short, the rewarding of a particular brightness did not significantly bias subjects in reward conditions to respond "Same" or "Different" any more or less often in size or weight judgments of black, white, and gray objects than was the case in the control group.

The present study sheds considerable light, however, in the area of methodology. The inclusion of two reward conditions in the experimental

design is significant. Because the majority of previous experimentation has employed only one reward condition, differential effects of different rewards could not be determined. Studies which attribute the direction of a particular response to the effects of only one reward fail to take into account the influence of other rewards of presumably equal reinforcement value that might affect perceptual reports in a different manner. In this study, an attempt was made to test for the effects of both black and white rewards. Although a finer discriminability appeared in judgments of subjects in white reward groups (See Figure 2), increased sensitivity cannot be attributed to the effects of reward training. If it is assumed that rewards enhance attention, one might have expected subjects to examine more closely discs, the brightnesses of which signified a previous reward, and to demonstrate better discriminability in size judgments of these discs as compared to the judgments of control subjects for whom the brightnesses of the discs were neutral. This did not hold true, however, in the judgments of subjects in black reward conditions, which revealed mean false alarm rates that approached mean proportions of hit rates.

If rewarding of particular brightnesses has no differential effect on same-different size judgments of experimental as compared to control groups, what, then, accounts for greater mean sensitivity in size judgments of white reward groups and a higher mean false alarm rate in the size judgments of black reward groups? The significance of using stimuli that differed in brightness may possibly be indicated here since a definite trend in the form of a contrast effect was exhibited in judgments of same colored discs as opposed to judgments of complementary colored discs. As shown previously,

mean hits were highest and mean false alarms lowest in judgments of white to white discs. Mean false alarms were highest and mean hits lowest in judgments of white to black discs. Similarly, both mean hits and mean false alarms were greater in judgments of black to black and black to gray discs than in judgments of black to white discs. Control group judgments fell between those of white reward and black reward groups. The varied brightnesses of the discs paired for judgments, seemed, then, to differentially affect same-different size judgments. Although this contrast effect may not be precisely designated as the major factor for the overall results demonstrated in the present study, it is offered as a possible consideration of what may have influenced the judgments of experimental groups.

In view of the above findings, further investigation is required in order to determine more fully the effect of reward on size and weight discrimination. Several modifications in the present experimental procedure may provide additional information in future research. The application of the assumptions and parameters of signal detection theory would be strongly suggested in future studies (Swets, 1973). The statistical indices derived from signal detection theory, $\underline{d}'$ and $\underline{\beta}$, were not completed in this study due to the small number of subjects in each group ($n = 5$) and the number of judgments (8) in each phase of the experiment. Also, because of the difficulty of the discrimination task and the lack of intrinsic interest in making successive series of size judgments, it was not feasible to prolong the experimental procedure to include more observations.

Other efforts in subsequent studies might be directed toward the development of a more effective reward training procedure. The reward

training in the Lambert, Solomon, and Watson (1949) study was continued for 10 days and was directly associated with the response of turning a crank. It may be that the indirect method devised for the present experiment was not sufficient to create a strong enough association between a reward for reporting black or white in the identification of the colors of balls and the brightness of a disc that was the same as the previously rewarded brightness.

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2. Murray, F. S. Effects of reward on children's size estimations. Unpublished manuscript, 1973.

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Footnote

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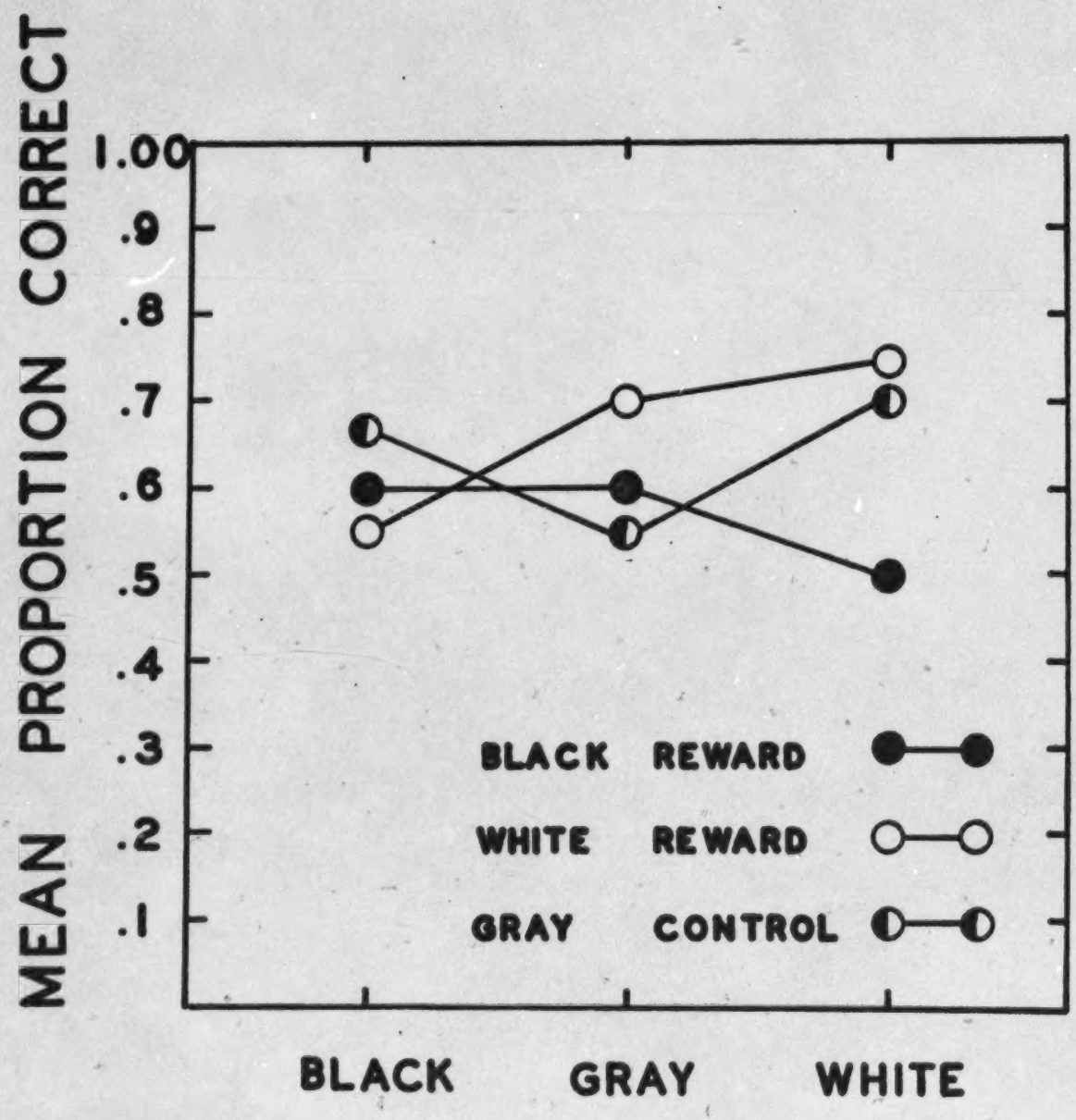
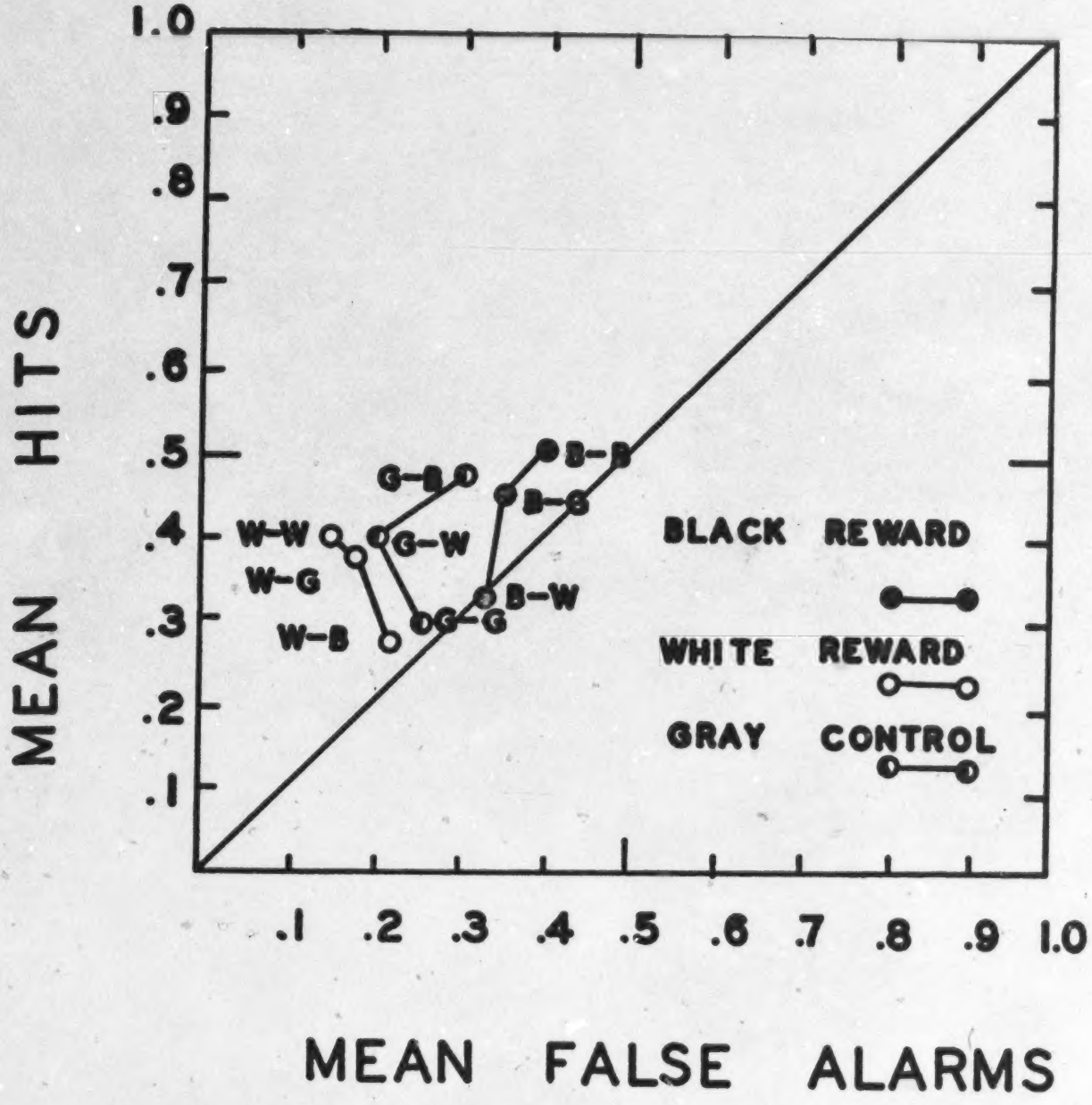
Figure Captions

Figure 1. Mean proportions of correct responses of black reward (B-B, B-G, B-W), white reward (W-B, W-G, W-W), and control (G-B, G-G, G-W) groups.

Figure 2. Mean proportions of hits to mean proportions of false alarms of black, gray, and white discs by black reward, white reward, and control groups. The diagonal line indicates the probability of chance performance (reports of "Same" and "Different" equally likely).



BRIGHTNESS COMPARISONS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